such additional performance properties without having to rely on additional additives or agents.

SUMMARY

[0005] Aluminum phosphate composite materials as disclosed herein comprise a core and shell structure, wherein the shell is formed from a material having an index of refraction that is higher than the core to provide an the composite material with an overall index of refraction that is greater than the core, and wherein the core is formed from a material having a reduced material cost when compared to the shell. In an example, the core comprises an aggregate of joined-together primary aluminum phosphate grains or powder, and the aggregate is hereby referred to an AlP particle. The AlP particle can comprise amorphous AlP, crystalline AlP, or a combination thereof. The AlP particle can have an average particle size of less than about 30 microns, in the range of from about 3 to 20 microns, and preferably in the range of from about 5 to 10 microns. The AlP can be made by precipitation, binary condensation, and sol gel methods of making.

[0005a] In one aspect of the present disclosure, there is provided an aluminum phosphate composite material comprising:

an aluminum phosphate particle forming a core of the composite material; and

a layer of pigment material disposed over an outside surface of aluminum phosphate particle and forming a shell over the core.

[0005b] In another aspect of the present disclosure, there is provided a chemical composition comprising the composite material as recited herein dispersed in a binding polymer.

[0005c] In a further aspect of the present disclosure, there is provided a chemical composition comprising:

an aluminum phosphate composite material comprising:

a plurality of cores formed from aluminum phosphate; and

a shell disposed at least partially over an outside surface of respective cores, the shells being formed from TiO_2; and

a binding polymer, wherein the aluminum phosphate composite material is dispersed in the binding polymer.

[0005d] In another aspect of the present disclosure, there is provided a coating composition comprising:

a binder polymer material; and

an aluminum phosphate composite material dispersed in the binder polymer material, wherein the aluminum phosphate composite material comprises:

a plurality of cores comprising amorphous aluminum phosphate; and

a shell disposed at least partially over an outside surface of a respective core, the shell being formed from a material having an index of refraction greater than the core.

[0005e] In a further aspect of the present disclosure, there is provided a method for making an aluminum phosphate composite material comprising the steps of:

forming a dispersion of aluminum phosphate particles; and

combining aluminum phosphate particles with a pigment material having an index of refraction greater than the aluminum phosphate particles so that the pigment material at least partially covers the aluminum phosphate particles to form the aluminum phosphate composite material.

[0006] In such example, the shell is provided in the form of a layer of pigment material disposed over an outside surface of the core. A preferred pigment material is TiO_2. The TiO_2 can have an average grain or powder size that is less than about 10 microns, in the range of from about 0.1 to 5 microns, and preferably in the range of from about 0.3 to 1 microns. The shell has a layer thickness that is at least about 0.0001 microns, and between about 0.001 to 2 microns, and preferably in the range of from about 0.01 to 1 microns. Generally, the shell layer thickness can comprise as little as a single grain, or can comprise several grains that are bonded or otherwise combined together on the core surface.

[0007] The shell may cover all or only a portion of the AlP core. In an example, the shell covers at least 20 percent of the total outside surface of the core, in the range of from about 30 to 100 percent of the total outside surface of the core, and preferably 20

percent of the core outside surface, and preferably in the range of from about 50 to 75 of the core outside surface. In an example, the TiO_2 is treated with or otherwise comprises a material that reacts with pendant POH groups from the AlP core to form a reaction product therebetween that operates to bond the shell to the core.